WINTER MORTALITY OF THE DOUGLAS-FIR BEETLE

On November 10, 1950, within the state of Colorado, the temperature dropped suddenly to -25°F. This drop followed a period of near-freezing minimum temperatures in and around Estes Park. The sharp lowering of the temperature was sufficient to produce considerable mortality in bark beetle broods. A second severe cold wave occurred over an extensive area during the week of January 29 to February 3, 1951 when the temperature fell to approximately -40°F.

There are several pocket-like bark beetle infestations of epidemic proportions in Douglas-fir in the Roosevelt National Forest and the Rocky Mountain National Park. Mr. Edward P. Merkel of the Fort Collins laboratory made a 1950 survey of these infestations and estimated 3460 firs infested with the Douglas-fir beetle, Dendroctonus pseudotsugae Hopk.

From February 15 to March 21, 1951, trees were randomly selected and felled in most of the outbreak areas as shown on the accompanying map. Bolts were removed from each bole at the lower and upper limits of infestation. These bolts then were taken to the laboratory for study. Mr. Ernest K. Field, Assistant District Ranger of the Rocky Mountain National Park generously assisted in the felling of trees and collecting of samples. Messrs. D. C. Weeks, F. T. Hutchison, and G. E. Feind also assisted in the field and laboratory work at various times.

In the laboratory the bolts were allowed to warm to room temperatures before sampling in order that living and dead individuals might be distinguished and counted separately. The method of sampling was to remove 6"x6" sections of bark from each of the four sides of the log. This made a total of eight samples per tree, four from the lower portion, Bolt A, and four from the upper portion, Bolt B. Notes were taken at the time the bolts were collected and examined to record location, altitude, terrain, stand density, height of samples, bark thickness, diameter, and degree of woodpecker work. For this investigation, two trees were sampled at each exposure or collection point.

The larvae and adults often occur within the bark. Hence, it was necessary to carefully strip away the bark of each quarter-foot section and thus expose the insects for counting. A flat-edged chisel-shaped wood carving tool proved excellent for this task. All larvae and adults found in the bark samples are listed in Table 1.

For this survey bolts were removed from 34 of an estimated infestation of 3460 trees. The counts, in 212 quarter-foot bark sections, were 484 living and 3172 dead larvae and adults, (a total of 3656 insects) a mortality of 86.8%. Two trees, numbers 28 and 29, with extremely thick bark, were included in this total. These trees contained a total of 126 living and 124 dead larvae, a mortality of 49.6%. Excluding these two trees from the grand total, the counts were 358 living and 2928 dead larvae and adults, a mortality of 89.5%. This figure is believed to be more representative than 86.8%.

Of the 3656 insects found, 1477 were larvae and 2179 adults. Ninety-five of the larvae were living and 1382 were dead, a larval mortality of 93.5%; of the adults 389 were living and 1790 were dead, 82.1% adult mortality. Here again, by excluding trees #28 and #29, and believed to be more representative, the mortality figures are 93.7% for larvae and 86.1% for adults.

Table 2 shows the relationship between bark thickness and brood mortality. Bark thickness greater than one and one-half inches is represented by only two sections, Bolts A of trees #28 and #29. Table 3 shows the relationship of bolt diameter to brood mortality.

Table 1. Bark Beetle Brood from Sections of Infested Douglas-fir

Tree # & Bolt	Coll. Point	Larvae No. Live	Larvae No. Dead	Larvae % Mort.	Adults No. Live	Adults No. Dead	Adults % Mort.	Totals No. Live	Totals No. Dead	Totals % Mort.
1 A	3	1	36	97	30	84	62	31	120	79.5
B		-	-	-	-	-	-	-	-	-
2 A	3	-	-	-	-	-	-	-	-	-
B		10	50	93	2	74	97	12	124	91.2
3 A	2	8	89	92	1	15	93	9	104	92.0
B		4	89	96	-	2	100	4	91	95.8
4 A	2	-	31	100	-	-	-	-	31	100
B		-	134	100	-	-	-	-	134	100
5 A	5	-	6	100	-	47	100	-	53	100
B		-	-	-	Limited	infested	height	-	-	-
6 A	5	-	49	100	-	-	-	-	49	100
B		-	-	-	-	-	-	-	-	-
7 A	4	3	58	92	5	24	83	8	82	91.1
B		-	-	-	-	-	-	-	-	-
8 A	1	6	63	100	-	-	-	6	63	92.1
B		4	71	95	-	-	-	4	71	94.7
9 A	1	36	106	75	-	12	100	36	118	76.6
B		1	59	98	-	-	-	1	59	98.3
10 A	6	-	9	100	26	62	71	26	71	73.2
B		-	15	100	-	9	100	-	24	100
11 A	17	1	15	94	32	97	75	33	112	77.2
B		-	-	-	-	-	-	-	-	-
12 A	17	-	12	100	-	87	100	-	99	100
B		-	18	100	-	9	100	-	27	100
13 A	18	1	36	97	-	28	100	1	64	98.5
B		-	-	-	-	-	-	-	-	-
14 A	18	-	18	100	-	33	100	-	51	100
B		-	17	100	-	8	100	-	25	100
15 A	15	-	14	100	2	71	97	2	85	97.7
B		-	8	100	-	55	100	-	63	100

Table 1. (Continued) Bark Beetle Brood from Sections of Infested Douglas-fir

Tree # & Bolt	Coll. Point #	Larvae No. Live	Larvae No. Dead	Larvae % Mort.	Adults No. Live	Adults No. Dead	Adults % Mort.	Totals No. Live	Totals No. Dead	Totals % Mort.
16 A	13	1	19	95	17	92	84	18	111	86.0
B		-	7	100	1	71	99	1	78	98.7
17 A	12	-	-	-	-	25	100	-	25	100
B		-	9	100	-	28	100	-	37	100
18 A	12	-	6	100	1	70	99	1	76	98.7
B		-	19	100	-	14	100	-	33	100
19 A	11	-	43	100	5	49	91	5	92	94.8
B		-	35	100	-	37	100	-	72	100
20 A	10	1	4	80	47	25	35	48	29	37.7
B		-	10	100	5	60	92	5	70	93.3
21 A	9	-	27	100	-	39	100	-	66	100
B		-	-	-	-	-	-	-	-	-
22 A	9	-	15	100	1	9	90	1	24	96.0
B		-	-	-	-	-	-	-	-	-
23 A	14	-	13	100	4	44	92	4	57	93.4
B		-	-	-	-	-	-	-	-	-
24 A	14	-	24	100	2	62	97	2	86	97.7
B		-	-	-	-	-	-	-	-	-
25 A	14	-	2	100	11	55	83	11	57	83.8
B		-	-	-	-	-	-	-	-	-
26 A	8	-	3	100	15	30	66	15	33	68.7
B		-	9	100	4	27	87	4	36	96.0
27 A	8	-	-	-	9	47	84	9	47	83.9
B		-	1	100	12	34	74	12	35	74.5
28 A	7	3	6	66	54	22	29	57	28	29
B		-	1	100	23	27	100	23	28	54
29 A	7	1	13	93	19	21	52	20	34	63
B		11	24	69	15	10	40	26	34	57
30 A	15	-	10	100	6	26	81	6	36	86
B		-	3	100	-	18	100	-	21	100
31 A	19	-	31	100	4	12	75	4	43	91
B		-	-	-	Limited infested height -			-	-	-
32 A	19	1	3	75	17	36	68	18	39	68
B		1	5	83	12	32	73	13	37	74
33 A	16	-	16	100	1	25	96	1	41	98
B		-	-	-	Limited infested height-			-	-	-
34 A	16	1	21	95	6	26	81	7	47	87
B		-	-	-	Limited infested height					
Totals		96	1382		389	1790		484	3172	

Table 2. Bark Thickness and Brood Mortality

Inches	Larvae (percent)	Adults (percent)
Less than 1"	96.2	90.9
1" to 1.5"	88.7	74.2
Greater than 1.5"	86.4	37.1

Table 3. Diameter and Brood Mortality

Inches	Larvae (percent)	Adults (percent)
6 - 10	96.8	90.1
10 - 14	91.9	92.6
14 - 18	93.5	71.8
18 - 24	87.9	46.6

Table 4. Site Altitude and Brood Mortality

Elevation	Larvae (percent)	Adults (percent)	Larvae and Adults (percent)
6000 - 8000	98.9	90.0	91.5
8000 - 10,000	94.0	72.3	82.0
Over 10,000	86.0		86.9

Table 5. Site Exposure and Brood Mortality (Weighted)

Exposure	Larvae (percent)	Adults (percent)	Larvae and Adults (percent)
Northerly	93.0	89.5	90.8
Southerly	94.6	65.0	78.0

Forty-four and seven-tenths percent of the total larvae and adults were in trees cut at elevations between 6000 and 8000 feet; 46.5% of the total larvae and adults were in trees taken from elevations between 8000 and 10,000 feet, Table 4. The low mortality of adults in trees between 8000 and 10,000 feet is due primarily to a predominance of the samples being from southerly exposures.

Two trees, #8 and #9, were cut above 10,000 feet. These trees contained a high percentage of larvae, both living and dead. It seems possible that at this high elevation two years are required to complete the life cycle.

Table 5 shows the relationship between exposure and brood mortality. Forty-six and four-tenths percent of the insects were from trees cut on northerly slopes. 53.6% were from trees cut on southerly slopes.

The objectives of this investigation were (1) to determine the percentage of winter mortality of the Douglas-fir beetle, and (2) to survey living Douglas-fir brood for use in cold temperature laboratory studies. After randomly selecting trees for winter mortality counts, a search was made in each outbreak area for trees with healthy brood for the cold temperature studies. However, none of the trees cut and sampled contained sufficient material.

Indications are that the abnormally low temperatures in November, 1950, and January-February, 1951, have effected good control of the Douglas-fir beetle. Both the Roosevelt National Forest and the Rocky Mountain National Park can be advised that artificial control measures in 1951 need not be taken.

Submitted by,

John A. Quist
Supervisory Control Aid (w.a.e.)

March 30, 1951

cc: Beal (3)
Rocky Mtn. Nat'l Park (2)
Regional Forester USFS (1)
Roosevelt N. F. (1)
Quist (1)
Circulate Western Stations (1)
Circulate Eastern Stations (1)

R 74 W R 73 W R 72 W R 71 W R 70 W R 69 W

T8N T7N T6N T5N T4N T3N T2N

ROOSEVELT NAT'L FOREST
ESTES PARK DIST.
Scale in miles
0 1 2 3 4 8 12